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GB 2223421 A GB 1543411 A FR 002466438 A
US 5807487 A

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(54) Abstract Title
Process and composition for water purification

(57) A process for treating water from household laundry comprises separating from a washing and/or rinsing step the waste-water which contains organic and/or inorganic soil, contacting the waste-water with one or more flocculents so as to form flocs, separating the flocs from the waste-water so as to produce purified water and reusing the water. Preferably the process involves a two-stage flocculation where the waste-water is contacted initially with a primary flocculent, eg aluminium ions/polyethylene imines, and then with a secondary flocculent, eg cationic polyelectrolytes. The invention also relates to a water purification composition comprising primary and secondary flocculents, and a kit for supplying unit doses of such flocculents.

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Process and Composition for Water Recycle

Field of the Invention

This invention relates to a product and method to enable consumers to re-use soiled wash water for example from washing processes.

Background

In many countries, laundry wash habits are labour intensive. Furthermore, laundry washing requires large quantities of water for washing and rinsing stages. Often, infrastructure may not allow use of automatic filling/draining machines, water may have to be collected by hand and waste-water disposal may even be problematic. Such water may be recycled in conventional ways by general waste-water treatment (sewerage) or disposal directly into waterways.

Water purification processes are well known in the art, for example in GB2004535A a water clarification process is described in which polyelectrolytes are used as a flocculent. These may be either nonionic, anionic or more preferably cationic polyelectrolytes. Coagulants such as particulate minerals may be used in addition to the polyelectrolyte to assist in coagulation. The invention is said to be useful in treating waterways e.g. river water.

GB1391578 also relates to compositions and methods for flocculating suspended solids. It relates in particular to the removal of particles having a particle diameter of less than 10 microns. The patent specifically relates to water intended to be used for drinking, as a municipal water supply. The patent teaches that in order to provide effective water clarification, a pre-mix of water -soluble cationic and nonionic polymers in specific ratios should be used.

SU891575 describes clarifying highly muddy raw water in a two stage treatment in which coagulation with aluminium sulphate is followed by filtration and subsequent treatment with polyacrylamide. SU1085942 relates to clarification of waste-water from bore holes which contain clay, petroleum products, polymers and surface active agents. The water is cleaned by treating with a mixture of polyacrylamide and a polyelectrolyte of polyethyleneamine and alkaline metal chlorides.

JP06071112, JP06309110, JP54073464, JP76042078 and JP51093550 also relate to processes for purifying water using flocculation.

In FR 2466438, a process is described for purifying water used in laundrettes so that it can be disposed of without overloading sewerage water treatment plants and without adding ingredients such as surfactants and phosphates directly into rivers. Aluminium sulphate and anionic polyelectrolyte are used as the flocculents.

However, all of the processes described above relate to industrial processes and do not solve the particular problems of the consumer as set out above.

Summary of the Invention

In accordance with the present invention there is now provided a process for treating water from a household laundry washing process comprising separating from the laundry the waste-water from the washing and/or rinsing step containing organic and/or inorganic soil, contacting the waste-water with the flocculent so that flocs are formed, separating the flocs out of the waste-water to produce purified water, and re-using the purified water.

In a preferred process according to the invention, the purified water is re-used in a further laundry process step, washing and/or rinsing. Such wash and/or rinse water may be purified for recycle more than once.

The invention also includes a water purification kit for household use comprising at least one unit dosage of flocculent, a unit dosage comprising from 0.5 - 250g flocculent and optionally means for removing flocs from treated water.

The invention also comprises a water purification kit comprising a water purification composition for household use comprising flocculent, means for providing unit dosages of flocculent and optionally, means for removing flocs from treated water.

Detailed Description of the Invention

Addition of the Flocculent: Water Treatment Step

After washing clothes and/or other items (laundry) in an aqueous liquor containing detergent, or after adding rinse water to carry out a rinse step, the waste wash or rinse water is separated from the wet laundry. This water will contain particulate and/or colloidal soils which are either organic and/or inorganic, in addition to detergent ingredients. In accordance with the process of the present invention the waste-water may be separated out by removal of the laundry from the water so that subsequent water treatment takes place in the washing container itself, or by draining off the liquor and collecting in a treatment container.

Flocculent is then added to the waste-water in the form of a solid, such as a powder or tablet, or in the form of a liquid such as an aqueous solution, or mixtures thereof. Where more than one flocculent is added, these may be added simultaneously or sequentially.

The Flocculent

The flocculent can be one or mixtures of more than one of the compounds which are typically used in water purification techniques to coagulate or precipitate suspended or colloidal soil. Preferred examples are salts of multivalent cations, such as salts of aluminium, manganese II or iron III. Preferred examples are aluminium salts, in particular aluminium chloride and/or aluminium sulphate and/or polymeric

aluminium chloride. Iron VI ions (ferate ions) may be preferred because, upon dissolution in water, iron III ions and peroxide will form so that some bleaching effect is added to the water for re-use, this may be advantageous particularly where the re-use stage is a laundry washing step. However, in general, the iron compounds may not be preferred in view of discoloration due to the presence of iron III ions.

Use of aluminium polyvalent metal ions is preferred. Whilst anhydrous or hydrated salts may both be used, hydrated salts are preferred. In particular, aluminium sulphate has been found to be particularly beneficial as it produces flocs which are rapidly formed and which float to the surface of the waste-water and can therefore be easily removed. In a particularly preferred aspect of the invention, hydrated salts of aluminium are used as flocculent. $AlCl_3.6H_2O$ and $Al_2(SO_4)_3.16H_2O$ are preferred and particularly $Al_2(SO_4)_3.16H_2O$, as these have been found to promote especially rapid floc flotation in waste laundry liquors. In a particularly preferred embodiment of the invention, the flocculent comprises mixtures of aluminium sulphate and aluminium chloride. The hydrated salts are particularly preferred. Mixtures of the aluminium sulphate and chloride salts comprising from 5 - 60%, preferably from 15 - 35%, more preferably from 20 - 30% aluminium sulphate and from 40 - 95% by weight, preferably 65 - 85%, more preferably 70 - 80% aluminium chloride are particularly preferred.

Organic flocculents are also suitable for use in the present invention. Examples of suitable organic compounds are polyelectrolytes. These may be used alone or may be used as additional flocculents for stabilising the flocs formed. Whilst nonionic and anionic polymers are also known in the art as flocculents, highly preferred organic flocculents for use in the present invention are cationic polymers, preferably having a high molecular weight. Many suitable synthetic polymeric materials are available and these are generally high molecular weight polyamides or polyamines. Particularly preferred are derivatives of polyacrylamide. Preferred molecular weights (M_w) based on viscosity measurements are in the range 10^5 to 10^7. Preferably the

molecular weight will be above 4 X 10^6, most preferably above 5 X 10^6. Molecular weights around 6 X 10^6 or higher are particularly preferred. Suitable materials may be made by copolymerisation of acrylamide and quaternary ammonium polyacrylamides.

The cationic polyelectrolytes are polymers preferably having a degree of cationicity (percentage of the number of side groups which are reacted to provide a cationic group) greater than 20%, more preferably greater than 30%, and even more preferably greater than 40% or even above 60%. Particularly preferred materials have a molecular weight above 4 X 10^6 and a cationicity greater than 40%. Examples of suitable polymers include Zetag 89, Praestol 611BC, Calfloc 1552, 1506 and 1508, and Polymin KP97 (tradenames).

Polyethyleneimines are also suitable although suitable materials tend to have less high molecular weights than the polyacrylamides.

In a preferred aspect of the invention, the flocculent comprises a primary flocculent and a secondary flocculent. As primary flocculents, polyvalent metal ions and/or polyethyleneimines (PEIs) are preferred. Polyvalent metal ions as described above are particularly preferred. As the secondary flocculent, one or more cationic polyelectrolytes may be used. Both primary and secondary flocculents may be added simultaneously. However, preferably, the primary flocculent will be added prior to addition of the secondary flocculent. Preferably after each addition of flocculent to the waste-water, the mixture will be stirred gently by hand as this promotes floc formation. Vigorous stirring may break up the flocs as they form and therefore is preferably avoided. Where flocculents are added sequentially, preferably there will be a gentle stirring step after the addition of each component of the flocculent. Such mixtures have been found to produce particularly effective floc formation; rapidly formed, high strength flocs, even when using low quantities of flocculent for the amount of soil present in the wash liquor.

The amount of flocculent required depends to some extent upon the level of soil in the waste-water for purification. Generally, the total flocculent required will be from 0.5 to 5 g/l water to be purified. If polyvalent metal salts are generally used in amounts of from 0.005 to 10 g/l water to be purified, preferably in amounts of from 0.1 to 2 g/l. A standard waste-water volume for treatment may be from 10 to 100 litres, more generally around 20 to 70 litres and more generally around 25 to 40 litres. Therefore, for such waste-water treatments, the preferred dosage for the salt of polyvalent cation is generally an amount of from 40-100 g, preferably 50-120g, more preferably 60-100g.

The flocculent preferably also comprises a polymeric material such as a cationic polyelectrolyte. Such components are preferably used in amounts of from 0.001-1 g/l water to be purified. More particularly, such polymeric materials are present in amounts of from 0.1 - 0.8 g/l. Generally such polymeric materials are added in solution for example, as a 1 - 10% by weight solution in water. Thus, for a standard waste-water volume to be treated, often around 30 litres, generally from 10-100ml of a 1% solution of a polymeric flocculent component will be used, preferably from 20-50 ml, for stronger concentrations proportionally equivalent lower volumes may be used.

In addition to the flocculent components mentioned above, floc building aids may also be added to the waste-water. Suitable as floc building aids are for example, clays and/or talc. Other optional additional ingredients in the water treatment step are dye fixation polymers which may be used to collect any dye remaining in the waste-water, for removal, pH-modifiers, deodorants, perfumes, antimicrobial agents, bleaching agents, dyes, suds suppressors. Dye fixation polymers in particular may be co-precipitated or trapped as part of the flocs formed during the floc formation.

The flocs formed in the process of the present invention are preferably strong so that they are not broken up substantially on separating out the flocs from the waste-water. Preferably, in addition, the flocs formed comprise a high proportion of large flocs, such as at least 60%, more preferably at least 80% of flocs having a diameter greater than 250 microns, preferably greater than 400 microns, more preferably greater than 750 and even above 1000 microns. The flocs will generally not have a floc diameter greater than 5000 microns, or may be up to a maximum of 2000 microns. It is particularly preferred for the flocs formed to have floc size such that at least 70% by weight of the flocs has a floc size between 1200 and 1900 microns. These measurements are based on the proportion of flocs which pass through or stay on sieve sizes as defined, when the waste-water containing flocs is poured through a sieve. Such large flocs are particularly preferred as they enable rapid separation of the purified water.

Separation out of Flocs

The flocs formed are then separated out from the waste-water by any convenient method. For example, especially where the flocs float, they may be removed from the surface of the waste-water by skimming off the flocs, or removal for example using an implement such as a ladle or spoon. Alternatively, where the flocs sink or float, the clear water may be removed from either above or below the flocs until the flocs would start to be carried over. At this point the floc-containing water may be treated as waste. Alternatively, the flocs may be removed by stirring a high surface area implement in the floc-containing waste-water, such as a brush which entraps the flocs and can then be removed. Such a brush can then be dried and the dried flocs easily removed. Alternatively, the flocs may be removed by a filtration process, either by draining the floc-containing water through a filter placed either at the exit point for water of the treatment container or the filter may be positioned at the entrance of a container into which the cleaned water is being passed for storage or immediate re-use. A filter may even be pulled through the floc-containing water to entrap the formed flocs. Suitable filters include any filters comprising an appropriate

mesh size. The mesh size should not be so small that very slow filtration is effected and the filter becomes blocked by the flocs. Equally, the filter should not have a mesh size which is so great that large amounts of the flocs pass through the mesh. Suitable materials include paper, textiles, metal, polymeric materials such as a foam material (polyurethane foam of standard pore sizes have been found to be particularly useful), or mineral materials such as porous stone beads. The preferred filters are at least partially flexible so that a filter can be fitted with ease, for example, into a washing machine or other treatment container.

Flocs may be removed from re-usable filters, such as metal or plastic sieves or textile filters or brushes, relatively easily, by brushing or scraping or other physical removal methods after drying.

If it is desired to ensure that the flocs formed will float for ease of removal, the flocculent components may be added to the waste-water for purification in addition to a gas-producing means. Such a gas-producing means may be provided by simply bubbling gas into the waste-water as the flocs form. Alternatively, an effervescence system may be added with the flocculent so that gas is released as the effervescence system contacts water. A particularly preferred effervescence system comprises an acid such as a carboxylic acid, for example, di or polycarboxylic acids. Suitable examples comprise malic acid, citric acid, tartaric acid, maleic acid, glutaric acid, adipic acid, succinic acid and mixtures thereof, and an alkali source such as a carbonate, bicarbonate or sesqui-carbonate salt or mixtures thereof. Generally alkali metal salts of the carbonates are used. These components may be added in any relative proportions to produce gas, generally they will be provided in substantially stoichiometric proportions. The effervescence system may also be used to ensure the appropriate pH of the purified water produced for re-use.

Re-Use of the Purified Water

After separation out of the flocs the water remaining is purified water which can be re-used. In a preferred aspect of the invention the water is re-used in a further laundry washing or rinsing step. Depending upon the re-use purpose of the purified water, the pH of the purified water may be modified. Preferably the flocculents are selected so that the purified water will have the desired pH for re-use, but a pH modifier may be added to produce the desired pH for any particular re-use purpose. For example, for a rinse step, in particular if it is intended to use a fabric conditioner, it is desirable for the purified water to have an acid pH, below 7 and generally from 2-6 or from 4-6. In order to produce rinse water having the desired pH, use of a flocculent comprising aluminium chloride can ensure that the desired acidic pH is obtained in the purified water. However, should the pH be too high or too low any acid or alkali, respectively, may be added prior to addition of the fabric conditioner, in an amount such that the desired pH results.

For re-use as rinse water, to which fabric conditioner will be added, it is particularly preferred to use mixtures of the aluminium sulphate and chloride salts comprising from 5 - 60%, preferably from 15 - 35%, more preferably from 20 - 30% aluminium sulphate and from 40 - 95% by weight, preferably 65 - 85%, more preferably 70 - 80% aluminium chloride are particularly preferred. Such mixtures have been found to be preferred compared to the use of sulphate salts alone as the use of sulphate salts alone tends to reduce the ability of fabric softeners to dissolve in the water.

An additional benefit of the present invention is that the perfumes and/or dyes from a laundry detergent may be carried over into the purified water. This results in rinse water having an attractive colour and/or fragrance for use in a rinse step. Thus in a further preferred aspect of the invention, the water purification process is used in combination with a laundry detergent comprising a fragrance which is judged to have a stronger odour than 3,7 dimethyl-2,6, octadiene-1-nitrile (geranyl nitrile). This assessment is made by a panel of five trained perfumers and a comparison is made

between a 20% by weight solution of the fragrance in diethyl phthalate compared with a 20% by weight solution of geranyl nitrile. The comparison should be carried out using smelling strips. Using such a perfume provides fragrance carry-over for re-use in the purified water, e.g. in a laundry rinse step.

In a further preferred embodiment, perfumes and/or dyes may be added with the flocculent to produce attractive fragrance and/or colour, suitable for use as a rinse water.

Where the purified water is to be re-used in a laundry washing step, it is desirable for the water to have a pH which is greater than 7. Again, either the flocculent is selected so that this automatically results or a pH modifier may be added prior to re-using the purifed water. Any alkali may be added to achieve the desired alkaline pH.

In particular, for re-use for washing steps, it has been found that efficiency of the detergents may be adversely affected by the presence of high electrolyte concentrations due to the addition of polyvalent metal salts as flocculents. It was found that this could be overcome by the use of an ion-exchange filter or by the addition, preferably to the purified water prior to the addition of laundry detergent, of chelant for the metal ions, optionally with pH-modifier to ensure the appropriate neutral to alkaline pH for laundry detergent maximum performance.

Suitable chelants include builders such as the water soluble and/or insoluble builders described below, but are preferably heavy metal ion sequestrants. Water-soluble builders and heavy metal sequestrants are preferred, particularly the latter. These may be added to the purified water in amounts to provide a concentration of at least a few ppm as even very low concentrations may be effective. For example, from 0.005 to 10 g/l may be added.

Heavy metal ion sequestrant

Heavy metal ion sequestrant are particularly preferred chelants for use in the present invention. By heavy metal ion sequestrant it is meant herein components which act to sequester (chelate) heavy metal ions. These components may also have calcium and magnesium chelation capacity, but preferentially they show selectivity to binding heavy metal ions such as iron, manganese and copper, or any other metal ion which has been added as a flocculent.

Suitable heavy metal ion sequestrants for use herein include organic phosphonates, such as the amino alkylene poly (alkylene phosphonates), alkali metal ethane 1-hydroxy disphosphonates and nitrilo trimethylene phosphonates. Examples include diethylene triamine penta (methylene phosphonate), ethylene diamine tri (methylene phosphonate) hexamethylene diamine tetra (methylene phosphonate) and hydroxy-ethylene 1,1 diphosphonate, 1,1 hydroxyethane diphosphonic acid and 1,1 hydroxyethane dimethylene phosphonic acid.

Preferred suitable heavy metal ion sequestrants for use herein include nitrilotriacetic acid and polyaminocarboxylic acids such as ethylenediaminotetracetic acid, ethylenediamine disuccinic acid, ethylenediamine diglutaric acid, 2-hydroxypropylenediamine disuccinic acid or any salts thereof.

Other suitable heavy metal ion sequestrants for use herein are iminodiacetic acid derivatives such as 2-hydroxyethyl diacetic acid or glyceryl imino diacetic acid, described in EP-A-317,542 and EP-A-399,133. The iminodiacetic acid-N-2-hydroxypropyl sulfonic acid and aspartic acid N-carboxymethyl N-2-hydroxypropyl-3-sulfonic acid sequestrants described in EP-A-516,102 are also suitable herein. The β-alanine-N,N'-diacetic acid, aspartic acid-N,N'-diacetic acid, aspartic acid-N-monoacetic acid and iminodisuccinic acid sequestrants described in EP-A-509,382 are also suitable. EP-A-476,257 describes suitable amino based sequestrants. EP-A-510,331 describes suitable sequestrants derived from collagen, keratin or casein. EP-A-528,859 describes a suitable alkyl iminodiacetic acid sequestrant. Dipicolinic acid

and 2-phosphonobutane-1,2,4-tricarboxylic acid are alos suitable. Glycinamide-N,N'-disuccinic acid (GADS), ethylenediamine-N-N'-diglutaric acid (EDDG) and 2-hydroxypropylenediamine-N-N'-disuccinic acid (HPDDS) are also suitable.

Especially preferred are diethylenetriamine pentacetic acid, ethylenediamine-N,N'-disuccinic acid (EDDS) and 1,1 hydroxyethane diphosphonic acid or the alkali metal, alkaline earth metal, ammonium, or substituted ammonium salts thereof, or mixtures thereof.

Water-Purification Composition

The present invention includes a water-purification kit for household use suitable for purifying water for re-use, the kit comprising at least one unit dosage of flocculent, a unit dosage comprising 0.03 - 250g flocculent, prefcrably from 0.05 to 100g flocculent. As described above, preferably the flocculent comprises a primary flocculent and a secondary flocculent, so that a preferred kit comprises primary and secondary flocculant, preferably in the form of separate unit dosages to be used in the process described above, either simultaneously or sequentially. In a particularly preferred kit according to the invention, the flocculant is therefore provided in two separate unit dosages comprising a first unit dosage comprising primary flocculent in an amount of from 10 - 200g where the primary flocculent comprises polyvalent metal ions or 0.03 - 5g where the primary flocculent comprises PEI, and a second unit dosage comprising secondary flocculent in an amount of from 0.01 to 20g, preferably 0.01 to 10g, most preferably 0.01 to 5g.

The unit dosages may contain other materials such as binders, fillers, processing aids, solvents and/or disintegrants. The unit dosages may also contain an effervescence system as described above and this may serve the dual function of producing gas to enhance flotation of the flocs formed and in addition, act as a disintegrant for the unit dosage form to ensure rapid release of the flocculent to the waste-water. Other

suitable disintegrants are those conventionally used in the pharmaceutical and tablet art, such as in EP 711828A, EP 488484A and EP 522766A.

The water purification kit may also contain a unit dosage pH-modifier and/or chelant as described above, where it is desired to re-use the purified water in a laundry washing step.

The present invention also comprises a water purification kit comprising the water purification composition and in addition a means for removing flocs formed, such as one or more filters or high surface area implements for collecting and removing flocs from the treated waste-water.

Example

Soiled laundry was washed in 30 litres of water with a standard dose of a commercially available phosphate-based laundry detergent composition, providing a concentration of laundry detergent in the wash water of 2500ppm.

After the washing process was completed, and the detergent suds had disappeared, the soil content in the water was 4g/l, determined by drying a sample in a drying oven at 120°C. Into the 30 litres of waste-water, were added 70g of a mixture of $Al_2(SO_4)_3.16H_2O$ and $AlCl_3.6H_2O$, the mixture comprising these components in a weight ratio 30:70. After gentle stirring for 10 seconds, 30ml of a 1wt % solution of Polymin KP97 (trade name of BASF) were added with gentle stirring for 90 seconds. Large flocs were formed. The waste-water containing the flocs was then drained from the water container through a polyurethane foam disc which captures the flocs and allows rapid permeation of the clear water through the foam for collection and re-use. The pH of the resulting purified water was approximately 4, resulting in a liquid suitable for re-use as a rinsing liquid, with an attractive clear appearance. The water was re-used in a laundry rinsing step to which a commercially available fabric softening composition was incorporated at the manufacturers recommended dosage.

CLAIMS

1. A process for treating water from a household laundry washing process comprising separating from the laundry the waste-water from the washing and/or rinsing step containing organic and/or inorganic soil, contacting the waste-water with a flocculent so that flocs are formed, separating the flocs out of the waste-water to produce purified water, and re-using the purified water.

2. A process according to claim 1 in which the flocculent is such as to generate floating flocs.

3. A process according to claim 1 or claim 2 in which the flocculent comprises multivalent cations, preferably aluminium.

4. A process according to claim 5 in which the aluminium is present as aluminium sulphate.

5. A process according to any preceding claim in which the flocculent comprises a cationic polyelectrolyte.

6. A process according to any preceding claim in which the flocculent comprises a primary flocculent selected from polyvalent cations, preferably aluminium ions, and polyethylene imines and mixtures thereof, and a secondary flocculant selected from cationic polyelectrolytes or mixtures thereof and contact with the waste-water is sequential such that in a first contacting step, the waste-water is contacted with the primary flocculent and is preferably stirred gently so that floc formation begins and in a second contacting step, the waste-water is contacted with the secondary flocculent preferably with subsequent gentle stirring.

7. A process according to any preceding claim in which the purified water is re-used in a further laundry process step, either washing or rinsing.

8. A process according to claim 8 in which the re-use step is a rinsing step in which fabric conditioner is added and the pH of the purified water is from 2 to 6, preferably from 3 to 5.

9. A process according to claim 8 in which the flocculent comprises a mixture of aluminium chloride and aluminium sulphate in respective weight percentages of 65 to 85% and 15 to 35%.

10. A process according to claim 7 in which the pH of the purified water is from 7 to 11, preferably from 8 to 10.5 and the re-use step comprises a laundry washing step.

11. A process according to claim 10 in which, prior to re-use a chelant is added to the purified water, to chelate the metal ions of the flocculent.

12. A process according to claim 11 in which the chelant comprises EDTA and/or EDDS.

13. A process according to any preceding claim in which the flocs are separated out of the waste-water using a brush.

14. A process according to any of claims 1 to 12 in which the flocs are separated out of the waste-water by pouring the waste-water through a filter.

15. A process according to any of claims 1 to 12 in which the flocs are separated out of the waste-water by lifting a filter or sieve through the floc-containing water.

16. A water purification composition for household use comprising flocculent, said flocculent comprising a primary flocculent selected from polyvalent metal cations and/or polyethyleneimines and a secondary flocculent comprising cationic polyelectrolytes or mixtures thereof.

17. A water purification composition according to claim 16 additionally comprising an effervescence system such that on addition to water, the composition produces/releases a gas.

18. A water purification kit for domestic use comprising at least one unit dosage or means for providing at least one unit dosage comprising 0.03-250g flocculent.

19. A water purification kit according to claim 18 comprising a first unit dosage comprising a primary flocculent selected from polyvalent metal ions or polyethyleneimines or mixtrues thereof, and a second unit dosage comprising a secondary flocculent selected from cationic polyelectrolytes or mixtures thereof.

The Patent Office

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Application No:	GB 9824398.3	**Examiner:**	Gavin Dale
Claims searched:	1-15	**Date of search:**	25 January 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): C1C (CACC, CRCC, CSCC, CTCC)

Int Cl (Ed.6): C02F 1/52, 1/54, 1/56

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2223421 A	(CHRYSOSTOMOS ANDREAS KAMBANELLAS) See Fig 1, page 4 lines 13-16 & page 6 lines 10-21	1 at least
X	GB 1543411	(THE REDUX CORPORATION) See Example on page 4	1 at least
X	US 5807487	(LAHTI) See column 1 lines 6-10, column 2 lines 62-64 & column 7 claim 1	1 at least
A	FR 2466438	(CTTN) See page 2 lines 2-10 & page 6 lines 7-9	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.